

FINAL TECHNICAL REPORT

Award: G16AC00369

Oklahoma Water Resources Board

“Oklahoma NGWMN Round II Final Report”

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Term: 10/31/2016 through 10/30/2018

Final Report: 1/18/2019

Background

The Oklahoma Water Resources Board (OWRB) exists to manage and improve the state's water resources. Our primary duties and responsibilities include water use appropriation and permitting, water quality monitoring and standards, financial assistance for water/wastewater systems, dam safety, floodplain management, water supply planning, technical studies and research, and water resource mapping. The OWRB has historically maintained an annual groundwater level measurement program that began in the 1950s with an expansion in the 1970s. This annual measurement program has varied in size but has continued uninterrupted since its inception, mainly informing drought monitoring in the state and allocation of water rights. US Geological Survey (USGS) Principal Aquifers that have been historically monitored include the Ada-Vamoosa (began in 1995), Arbuckle Simpson (began 1994), Blaine (began 1950), Central Oklahoma (began 1977), High Plains (began 1966), Rush Springs (began 1976), and Trinity (began 1981) Aquifers. With the initiation of the Groundwater Monitoring and Assessment Program (GMAP) in 2013, this annual monitoring network's density has been improved. The Ada-Vamoosa currently has 38 annual monitoring sites, Arbuckle Simpson has 18 sites, Blaine has 25, Central Oklahoma has 49, High Plains has 202, Rush Springs has 83, Trinity has 30 sites, and Ozark Plateaus has 7. The OWRB began the process of becoming a data provider to the National Groundwater Monitoring Network (NGWMN) in January 2016 with a one-year grant.

The Groundwater Monitoring and Assessment Program (GMAP) includes water quality sampling and water level measurement networks, aiming to characterize both the ambient quality and quantity of the state's major aquifers. The monitoring network for each aquifer is a comprehensive water level network comprised of wells measured once or thrice a year with a subnetwork of wells equip with continuous water level recorders. A water quality sampling network consisting of about 35% of the baseline sites is scheduled to be implemented in 2019 for sampling to occur every 1, 3, or 5 years depending on the rate of quality and quantity variability in a given aquifer. In general, this network strives for a density of 1 quality site per 100-150 km² and 1 quantity site per 50-100 km², dependent on the areal extent of the aquifer. Baseline evaluations have been completed for the Ada-Vamoosa (2014), Arbuckle Simpson (2015), the Central Oklahoma (2014), the southern non-Panhandle portion of the High Plains (2013), the Rush Springs (2013), the Trinity (2015), the High Plains (2016), and the Ozark (2017) Aquifers. A baseline evaluation was completed in the fall of 2018 to bolster networks across the state with a lower density and irregular distribution. The Blaine (2015) and the Ozark Plateaus (2017) were completed for water level-only baseline evaluations. Three continuous water level recorders were installed in the Ozark aquifer during the baseline assessment. These sites will be uploaded to the well registry and groundwater level data will be passed to the portal in the future.

GMAP also collects data multiple times a year through a trend network to recognize seasonal changes, changes due to climate, and/or changes due to usage over time. The Water Level Trend monitoring network is implemented after baseline evaluation is completed and measures sites three times a year. This network consists of about 50% of the baseline water level sites. The Ada-Vamoosa currently has 18 trend monitoring sites, Arbuckle Simpson has 11 trend sites, Blaine has 8, Central Oklahoma has 25, High Plains has 43, Rush Springs has 31, Trinity has 10 trend sites, and Ozark Plateaus has 5. To facilitate this effort, several wells have been equipped with water level data loggers.

In addition to the existing continuous water level data already being provided, the OWRB strives to become a more comprehensive data provider. Continuous data recorder sites in each Principal Aquifer should be able to fulfill the NGWMN minimum density goal of 1 site per 1,000 mi². With the addition of OWRB trend water level sites, manually measured three times per year, density goals for the NGWMN trend network based on usage and development of the Principal Aquifers could potentially be met. The OWRB's annual water level sites should be able to fulfill density goals for the NGWMN surveillance network. For the first year's agreement, ten continuous recorder sites were entered into the NGWMN registry for the trend water level network; five sites in the Rush Springs Aquifer and five sites in the Central Oklahoma Aquifer.

Continuous recorder water-level data is currently housed in Aquatic Informatics' Aquarius Time-Series software. Lithologic, well construction, and manual water-level data is currently housed in the OWRB Well Driller's Database. Both of these systems are internal access but the Aquarius Time-Series software is now linked to the Aquarius Web Portal, also provided by Aquatic Informatics. This system allows access to all OWRB continuous and real-time data and is customizable to allow either username/password access or complete access to the public. IT Staff have several years' experience in end-to-end support of Microsoft Windows networks, Microsoft SQL Server and Oracle Enterprise Database Management Systems, PC hardware and software support, enterprise document management systems as well as programming and support for state agency websites, custom Windows applications and database-centered web applications. Security requirements include generic IT-centric security policies such as protecting sensitive attorney-client privilege data, safeguarding publicly identifiable information, and maintaining IT infrastructure security.

IT Service Updates

The OWRB through its Water Quality Programs Division and IT staff with the Office of Management and Enterprises (OMES) successfully connected its time series database (Aquarius) to the USGS web portal in February 2017 which provided access to continuous water level data to the previously mentioned 10 sites spanning two aquifers. This work completed the objective from the Round I grant period (2016-2017) related to connectivity of our database to the USGS data portal.

Through collaboration between GMAP staff and OMES IT staff, additional well metadata is being provided by OWRB to the USGS. Additional data being delivered under this agreement includes complete lithology, casing depth, casing diameter, casing type, screened interval, screen diameter, and screen type along with the already existing service of continuous daily mean water levels.

Several challenges were encountered in this process, including IT and administration. Since 2017 when the initial service was established, there have been wholesale OMES administration process changes and OMES technical staff has turned over in several key areas. The biggest administration challenge to note is the spending of funds designated for IT in this grant award. This project was improperly designated by OMES as an "improvement" as opposed to a "project", which disallowed OMES to bill any time out to the NGWMN project. Therefore, any IT costs accrued for the fulfillment of this grant were billed under OWRB's general maintenance agreement with OMES, resulting in no IT funding being spent from the grant in question. Once funding and IT personnel were secured and in

place, OWRB and OMES staff were able to collaborate to solve issues outlined in the year one progress report such as transferring and storing data properly across divisions, and ensuring that data gaps are properly designated in OWRB databases.

Missing Optional Metadata

Although all IT objectives were met for this grant period, there were several wells that were identified as having incomplete records for well construction details. All of the wells with incomplete records are getting pushed to the USGS web service as unavailable until manual work can be done to complete the well records. In the vast majority of cases, these well records are incomplete due to the incomplete filing of a well record by the well driller themselves, or because the well predates the requirement for a well log to be submitted for new well construction. In the case that a well log does not exist, long term water level data predating the implementation of GMAP, has been used to confirm the connectivity and representativeness of this well to the aquifer of interest.

Future work to remedy these data gaps include slug testing and downhole camera work to investigate or confirm casing, screen, and lithology details where available. This work has already been approved and funded through a Round III NGWMN grant (G18AC00071) through the USGS and is expected to take place over the next two years. Upon completion, this metadata will be updated in OWRB databases and therefore available to the USGS web services.

New Sites

One main objective outlined for this grant was for OWRB to expand the network of wells being monitored by continuous water level recorders in addition to the 10 existing sights already active. Seven sites were selected for their location in the Blaine (one site), Arbuckle-Simpson (three sites), and High Plains (locally known as the Ogallala, three sites) aquifers. All methods for site selection, field techniques, data quality assurance processes, and data storage outlined in OWRB's initial new data provider document (G16AC00020, submitted 3/2017) were adhered to while selecting and providing all additional sites for this grant. All seven sites are designated as "unconfined" with three wells (High Plains) designated as having documented anthropogenic interference while the other four (one Blaine, three Arbuckle-Simpson) are sub-categorized as background sites. The IT service updated mentioned in the section above also applies to the new sites added as a part of this grant. All minimum data elements are met for all new wells, although some sites lack the casing, screen, or lithologic information as mentioned in the "Missing Optional Metadata" section. As mentioned, any missing information will be investigated across 2019 and 2020 and available to the USGS web portal soon thereafter.

Well Drilling

Well drilling activities planned for the Ozark aquifer in NE Oklahoma under this grant could not be accomplished. Although substantial time was input into writing and soliciting bids for the well drilling, well drilling bids came in substantially over the budgeted allowance (95K in state funds, 30K in federal funds). The project was scaled down (from 3 sites and 4 wells to 1 site and 2 wells) and re-bid but no new bids were received. The OWRB inquired the USGS if funding allocated for well drilling could be re-

purposed and learned that it could not. As a consequence, the \$30,000.00 of federal funds dedicated for drilling observation wells in the Ozark aquifer were not spent.

Additional Information

The OWRB representative for the NGWMN has changed. Brittany McCall left the OWRB in February of 2017 and Kyle Mattingly began in November of 2016 which allowed for a cross training period before Brittany's departure. Mark Belden is still the Groundwater Monitoring Section Head. Please treat Kyle Mattingly as the point of contact for any questions regarding the OWRB's involvement in the NGWMN, but continue to cc Mark Belden in all communications. If Kyle Mattingly is not available or unresponsive, Mark Belden is the next point of contact.

Summary

Updates to OWRB IT services were completed to address issues in storage and transferring of water level data to the USGS web portal. OWRB also collaborated with OMES IT staff to establish a connection between OWRB's Well Driller's Database and the USGS web portal for the purpose of providing well casing, well screen, and lithologic data. Whereas the connection has been made and is active and working, there are some gaps in the data mentioned. These gaps will be evaluated and remedied over the course of a two year period.

OWRB identified seven new sites across three aquifers to provide to the NGWMN. All seven sites are equipped with continuous water level recorders recording a daily mean water level all year. All of these sites have been assessed and managed the same as the 10 sites previously added. All changes in IT services made to the OWRB's data management and web services also apply to these new sites.

Overall, two of the three objectives were completed for this grant award with a return of funds on IT services and well drilling due to circumstances outside of OWRB's control. Plans to expand on the work done during this two year period are scheduled for 2019 and 2020 through a third cooperative grant with the USGS (G18AC00071).